Preparing for Phase 6 of the Coupled Model Intercomparison Project (CMIP6)

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- Initial proposal for the design of CMIP6 to inform interested research communities and to encourage discussion and feedback for consideration in the evolving experiment design.

- For details of this proposal, see

  Meehl, G. A., R. Moss, K. E. Taylor, V. Eyring, R. J. Stouffer, S. Bony, and B. Stevens, Preparing for Phase 6 of the Coupled Model Intercomparison Project (CMIP6), Eos, Transactions American Geophysical Union, subm., 2013.

- Feedback on this initial CMIP6 proposal is being solicited over the next year from modeling groups and model analysts. Please send comments to CMIP Panel chair, Veronika Eyring, Veronika.Eyring@dlr.de by September 2014. The WGCM and the CMIP Panel will then iterate on the proposed experiment design, with the intention to finalize it at its meeting in October, 2014.

CMIP6: Toward understanding past, present and future climate (organized by the WCRP Working Group on Coupled Modelling (WGCM))

- Since 1995, the **Coupled Model Intercomparison Project (CMIP)** has coordinated climate model experiments involving multiple international modeling teams.
- CMIP has led to a better understanding of past, present and future climate change and variability.
- CMIP has developed in phases, with the simulations of the fifth phase, CMIP5, now mostly completed.
- Though analyses of the CMIP5 data will continue for at least several more years, science gaps and outstanding science questions have prompted preparations to get underway for the **sixth phase of the project (CMIP6).**
- We describe here an **initial proposal for the design of CMIP6** to inform interested research communities and to encourage discussion and feedback for consideration in the evolving experiment design.

Meehl et al., EOS, 2014

CMIP History

- CMIP3 provided data for IPCC AR4
  - About 20 TB of data used in AR4, currently ~36TB
  - 20+ climate models from 14+ groups
- CMIP5 provided data for IPCC AR5 (just out)
  - More than 1.5 PB of data and growing
  - 50+ climate models from 25+ groups

CMIP5 Highlights

- CMIP becoming very large
- First attempts at model documentation
- Decadal prediction and Earth System Models were new science experiments
- Data public, distributed on servers around the globe
  - Lots of early problems with distributed data serving

CMIP6 Under-Development

- Survey: data users and providers (mainly WG1 to date)
  - Less runs/data
  - More “science” runs and analysis
- New structure and focus
  - Back to science focus => big role for MIPs
  - Focus on big picture questions
  - Current proposal being discussed, nothing final at this point in time

Initial CMIP6 Proposal: Scientific Focus

- The specific experimental design would be focused on **three broad scientific questions**:
  1. How does the Earth System respond to forcing?
  2. What are the origins and consequences of systematic model biases?
  3. How can we assess future climate changes given climate variability, predictability and uncertainties in scenarios?

Meehl et al., EOS, 2014

Initial CMIP6 Proposal: Scientific Focus

- It is proposed to use as the **scientific backdrop** for CMIP6 the six **WCRP Grand Challenges**, and an additional theme encapsulating questions related to **biospheric forcings and feedbacks**.
  1. Clouds, Circulation and Climate Sensitivity
  2. Changes in Cryosphere
  3. Climate Extremes
  4. Regional Climate Information
  5. Regional Sea-level Rise
  6. Water Availability
  7. AIMES theme for collaboration: biospheric forcings and feedbacks

Meehl et al., EOS, 2014

Initial CMIP6 Proposal: A Distributed Organization under the oversight of the CMIP Panel

CMIP would be comprised of two elements:

1. **Ongoing CMIP Diagnostic, Evaluation and Characterization of Klima (DECK) experiments:** a small set of standardized experiments that would be performed whenever a new model is developed.

The DECK experiments are chosen to provide **continuity across past and future phases of CMIP**, to evolve only slowly with time, and to take advantage of what is already **common practice in many modeling centers**:

i. an AMIP simulation (~1979-2010);

ii. a multi-hundred year pre-industrial control simulation;

iii. a 1%/yr CO_2 increase simulation to quadrupling to derive the transient climate response;

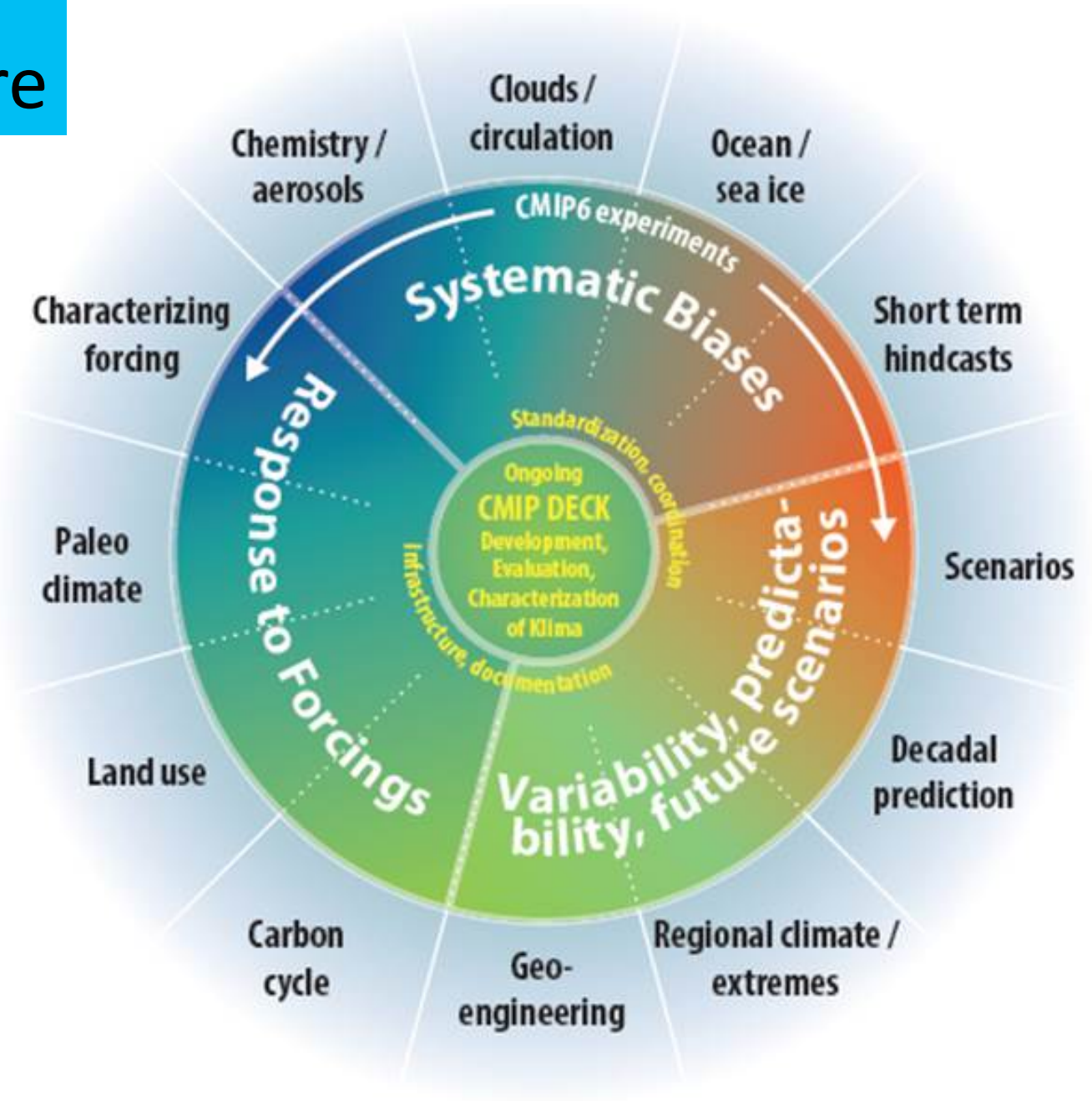
iv. an instantaneous 4xCO_2 run to derive the equilibrium climate sensitivity;

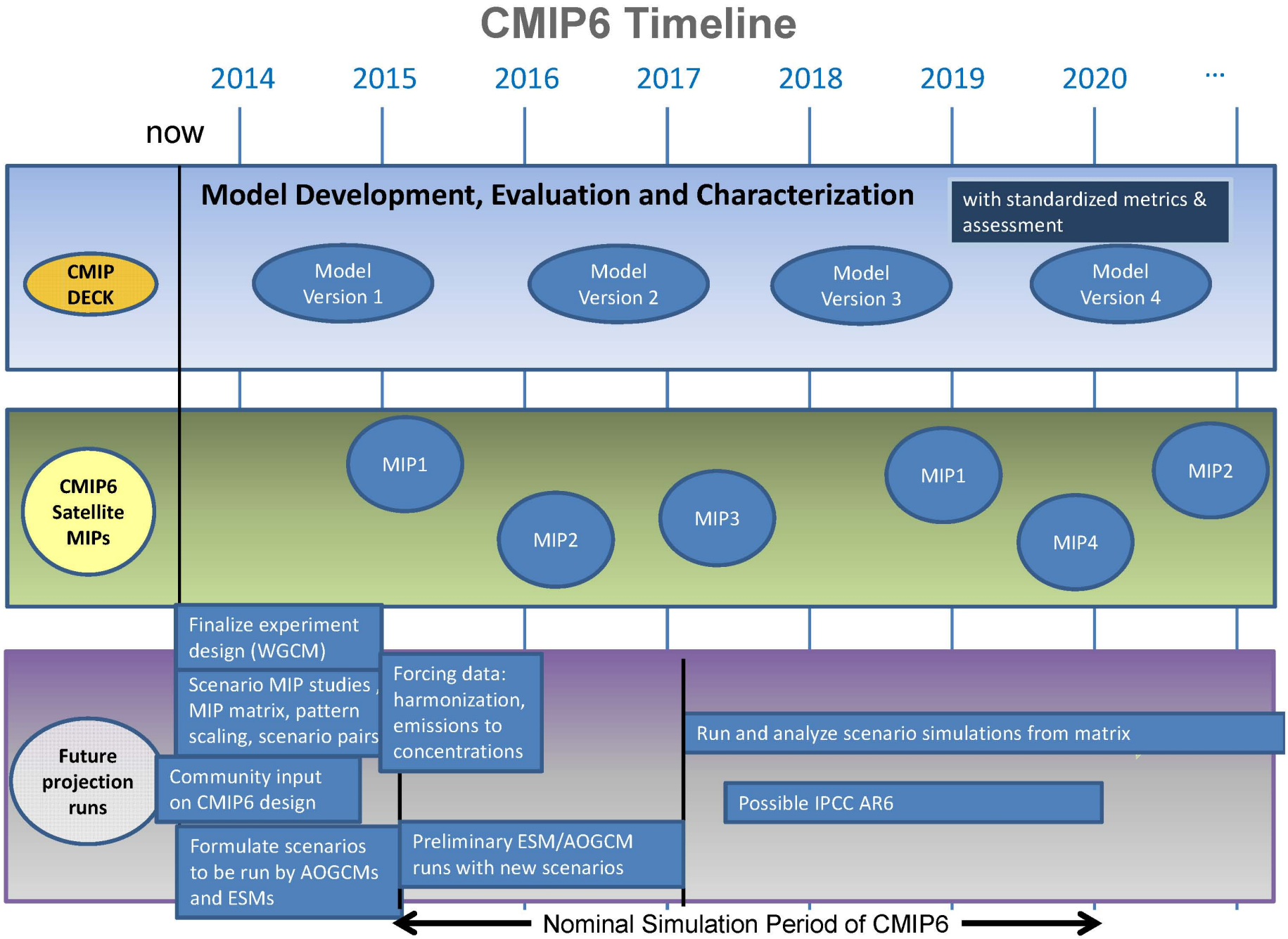
v. a simulation starting in the 19th century and running through the 21st century using an existing scenario (RCP8.5).

2. **Standardization, coordination, infrastructure, and documentation functions** that make the simulations and their main characteristics performed under CMIP available to the broader community.

Meehl et al., EOS, 2014

CMIP6 Structure




CMIP6 Timeline
2014
2015
2016
2017
2018
2019
2020
...
now
Model Development, Evaluation and Characterization
with standardized metrics & assessment
CMIP DECK
Model Version 1
Model Version 2
Model Version 3
Model Version 4
CMIP6 Satellite MIPs
MIP1
MIP2
MIP3
MIP1
MIP4
MIP2
Finalize experiment design (WGCM)
Scenario MIP studies , MIP matrix, pattern scaling, scenario pairs
Forcing data: harmonization, emissions to concentrations
Run and analyze scenario simulations from matrix
Future projection runs
Community input on CMIP6 design
Possible IPCC AR6
Formulate scenarios to be run by AOGCMs and ESMs
Preliminary ESM/AOGCM runs with new scenarios
Nominal Simulation Period of CMIP6

Roles and Responsibilities

Communication

- **CMIP Panel facilitates communication** between MIP co-chairs and the model group contacts to help with coordination between MIPs, and between the MIPs and the modeling groups

CMIP Panel:

- Coordinate diagnosis and evaluation simulations with the community
- approve experiments and variable lists etc. that are to be part of CMIP6
- Coordinate with WCRP Grand Challenges

MIPs:

- Address WCRP Grand Challenges and science questions
- Suggest model simulations to address these science questions
- Work with CMIP Panel for output list for CMIP6 data request, and supply rationalization for relevance of experiments to address science questions
- **MIPs determine which experiments are run when**

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For CMIP5 survey: email:

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Initial CMIP6 Proposal: Acknowledgements

- The authors acknowledge the Aspen Global Change Institute (AGCI) for hosting a CMIP6 planning workshop in August 2013 as part of its traditionally landmark summer interdisciplinary sessions.

- NASA, NOAA, DOE, and NSF, as well as the international global change communities, the WCRP and IGBP, all provided support for the workshop.

- The CMIP6 proposal presented here substantially draws on conclusions from that workshop, and the authors acknowledge contributions from, and discussions with, the AGCI workshop participants, as well as subsequent discussions at the WGCM meeting in October, 2013, in Victoria, Canada, joint with the Analysis, Integration and Modeling of the Earth System (AIMES).

- A related workshop convened by the Energy Modeling Forum is documented here: http://emf.stanford.edu/events/series/snowmass/ .

Meehl et al., EOS, 2014